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Hydrogen technologies

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ISO TC 197/WG 22

Gaseous hydrogen -- Fueling stations -- Part 5: Hoses

CD Ballot

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

The committee responsible for this document is ISO/TC 197, *Hydrogen technologies*.

A list of all parts of the ISO 19880 series can be found on the ISO website.

Introduction

This International Standard is to promote the implementation of performance based testing for components of dispensing systems and fueling stations that are based on proven engineering principles, research and the combined expertise of gas utilities, fuel providers, manufacturers, users, and others having specialized experience.

The successful commercialization of hydrogen vehicle technologies requires codes and standards pertaining to fueling stations, vehicle fuel system components, and the global homologation of standards requirements for technologies with the same end use. Essentially this will allow manufacturers to achieve economies of scale by producing one product for use globally.

International harmonization contributes to reducing technical barriers and stimulates related markets. A series of standards that address hydrogen-fueled vehicles and fueling stations is being developed. These standards will provide internationally homologized minimum safety performance criteria at the component level, thus providing a foundation to build a safe “fueling system.”

This Standard was developed using the following document: *CSA HGV 4.2 Hoses for Compressed Hydrogen Fuel Stations, Dispensers and Vehicle Fuel Systems,* under a Copyright License Agreement between CSA and ISO.

This document was developed based on two types, five classes and two ratings of wire or textile reinforced hoses and hose assemblies suitable for use with gaseous hydrogen for hydrogen dispensing at specified temperature ratings. This is based on technologies in use at the time of the development of the requirements. In the future, other types and classes of hoses and hose assemblies will need to be evaluated to determine the suitability of requirements in this document.

This standard applies to newly manufactured hose and hose assemblies for:
• connecting the dispenser to the fueling nozzle, high pressure (class A)
• flexible hoses used on hydrogen fuel station equipment (class B)

Note: Class B hoses include all station side hydrogen hoses where flexibility and acceptable to the certification agency is necessary.

Gaseous hydrogen -- Fueling stations -- Part 5: Hoses

1 Scope

1.1 General

This standard contains safety requirements for material, design, manufacture and testing of gaseous hydrogen hose and hose assemblies which are used for hydrogen fueling station applications.

This standard does not apply to hoses used onboard a vehicle.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/TS 19880-1:2016, *Gaseous Hydrogen – Fueling Stations — Part 1: General requirements*

ISO 188: *Rubber, vulcanized or thermoplastic – Accelerated aging and heat resistance tests*

ISO 1402:2009, *Rubber and plastics hoses and hose assemblies — Hydrostatic testing*

ISO 4671, *Rubber and plastics hoses and hose assemblies — Methods of measurement of dimensions*

ISO 4080:2009, *Rubber and plastics hoses and hose assemblies - Determination of permeability to gas*

ISO 6802, *Rubber and plastics hose and hose assemblies with reinforcements - Hydraulic Impulse test with flexing*

ISO 6803, *Rubber or plastics hoses and hose assemblies — Hydraulic-pressure impulse test without flexing*

ISO 7326:2006, *Rubber and plastics hoses — Assessment of ozone resistance under static conditions*

ISO 8031:2009, *Testing methods for rubber and plastics hoses -- Part 5: Determination of electrical resistance*

ISO 9227:2012, *Corrosion tests in artificial atmospheres — Salt spray tests*

ISO 10619-2:2011, *Rubber and plastics hoses and tubing — Measurement of flexibility and stiffness ─Part 2: Bending tests at sub-ambient temperatures*

ISO 30013:2011, *Rubber and thermoplastics hoses- Methods of exposure to laboratory light sourses - Determination of change in color, appearance and physical properties*

3 Terms and definitions

For the purpose of this standard, the following apply.

3.1 bend restricter

A device that limits or restricts the stress concentration at the location where the hose is connected to the fitting to reduce the tendency for kinking and hose abrasion at that location

3.2 dispenser hoses
fueling hose

flexible conduit used for dispensing gaseous hydrogen to vehicles through a fuelling nozzle

3.3 fill pressure

The maximum pressure attained at the actual time of filling. Fill pressure varies according to the ambient temperature, the temperature of the fuel being delivered to the dispenser and the initial pressure of the vehicle to be filled. Maximum fill pressure is limited 1.25 times the service pressure, H35, H70.

3.4 fuel temperature

temperature of the hydrogen fuel, measured less than 1 meter upstream of at the dispenser hose breakaway.

3.5 hose breakaway device

device installed on a dispensing hose that separates when a given pull force is applied and closes the flow of hydrogen to prevent gas leakage and protect the dispenser from damage from vehicles driving away

3.6 maximum allowable temperature

maximum allowable temperature is the maximum temperature for which the manufacturer has designed the hose or hose assembly when handling the specified fluid at the specified pressure

3.7 maximum allowable working pressure (NAWP)

maximum pressure that a component may experience in service, including upset conditions, independent of temperature, before initiating mitigation options, and typically the basis for the set point of the pressure relief device protecting the vessel or piping system.

NOTE The maximum allowable working pressure may also be defined as the design pressure, the maximum allowable operating pressure, the maximum permissible working pressure, or the maximum allowable pressure for the rating of pressure vessels and equipment manufactured in accordance with national pressure vessel codes.

3.8 maximum fill pressure
maximum operating pressure (MOP)

highest pressure that is expected for a component or system during normal operation

NOTE This is the pressure from which hydrogen at a temperature of 85ºC would settle at the NWP at a temperature of 15ºC.

3.9 nominal working pressure (NWP)
service pressure

pressure for which the dispenser is intended to be operated for a given gas temperature of 15 ºC.

NOTE This defines a full vehicle tank gas density, of either 35MPa or 70MPa at 15°C.

3.10 pressure relief device (PRD)

device designed to release pressure in order to prevent a rise in pressure above a specified value due to emergency or abnormal conditions

3.11 receptacle

device connected to a vehicle or storage system which receives the nozzle [ISO 17268-2]

NOTE This can also be referred to as a fuelling inlet of gas filling port in other documents.

4 Instruction Manual

Instructions covering proper selection, installation, inspection, maintenance, safety precautions and usage shall be provided.

The instructions shall include, as a minimum, statements to the effect that:

a. The hose shall not be stretched, kinked, twisted or torqued;

b. The hose is suitable for use with gaseous hydrogen;

c. The maximum allowable working pressure which is marked on the hose must not be exceeded; when the hose is marked with a pressure Class (H35, H70) the user must provide overpressure protection to prevent operation of the hose at pressures greater than the allowable MAWP.

d. Dragging, dropping, contact with sharp objects or edges, and exposure to chemicals shall be avoided.

e. The manufacturers specified minimum bend radius for the hose;

f. The hose shall not be subjected to temperatures outside the temperature limits marked on the hose;

g. The hose shall not be used in a vehicle.

h. The manufacturer shall provide appropriate installation instructions.

i. The hose assembly shall be of adequate length for the intended use. Hose assemblies shall not be joined together to achieve the required length

j. The hose assembly complies with this International Standard

k. The hose assembly shall be inspected in accordance with the manufacturer’s instructions. The manufacturer’s instructions shall address such items as:

1. Leakage, in accordance with the applicable installation code.
   CAUTION: Matches, candles, open flame or other sources of ignition shall not be used for this purpose. Leak test solutions may cause corrosion — water rinse after test.
2. Soft spots, bulges, blisters, kinks or stretching in the hose,
3. Excessive abrasion exposing the hose reinforcement.
4. Cuts or cracks in the hose that expose or damage the reinforcement.
5. Evidence of end connector movement or slippage with respect to the hose.
6. Electrical conductivity.
7. Safety Precautions.
8. Guidelines for replacement.

l. The hose assembly shall provide protection for the user from contact damage.

5 Classification

5.1 Types

Hose assemblies for this application are classified according to end use as follows:

Type A: connecting the dispenser to the fueling nozzle.

Type B: flexible hoses used on hydrogen fuel station equipment, which are not accessible to the public

NOTE Type B hoses include all station side hydrogen hoses where flexibility is necessary and acceptable to the certification agency.

5.2 Classes

Each types of hose assemblies shall be designated according to five classes, depending on the pressure used for dispensing hydrogen distinguished by each category of pressure defined in clause 3. Terms and Definitions as shown in Table 1.

Table 1 — Pressure classes

Pressure class	H11	H25	H35	H50	H70
NWP[a](MPa)	11	25	35	50	70
MOP[b](MPa)	13.75	31.25	43.75	62.5	87.5
MAWP[c](MPa)	15.13	34.38	48.13	68.75	96.25
Nominal size	H11	H25	H35	H50	H70
6.3	N/A	N/A	X	N/A	X
8	N/A	N/A	N/A	N/A	X
10	N/A	N/A	X	N/A	N/A
Other sizes	TBD	TBD	TBD	TBD	TBD
NOTE X = Applicable; N/A = Not applicable.					
a Nominal Working Pressure b Maximum Operating Pressure (1.25 x NWP) c Maximum Allowable Working Pressure (1.1xMOP)					

5.3 Rating

Temperature ratings for hose assemblies shall be suitable for use at a temperature range of -40°C to 65°C or as stipulated by the manufacturer.

Rating T0: hoses have the operating temperature range stipulated by the manufacturer.
Rating T1: hoses have the operating temperature range of -40^{o}C to 65^{o}C.

6 Materials and construction

6.1 General

The construction of hose parts not specifically covered by this standard shall be in accordance with industry recognized practices of safety, substantiality and durability.

All specifications as to construction set forth herein may be satisfied by the construction actually prescribed or such construction as will provide at least equivalent performance.

6.2 Lining

The lining shall consist of rubber or thermoplastic material and be of uniform thickness and free from defects. Defects may include but are not limited to bubbles, thinning, gouging or discoloration.
The lining may also consist of multiple material layers.

6.3 Reinforcement

The reinforcement consists of one or more layers of suitable wire or textile material applied by any suitable technique.

6.4 Cover

The cover shall consist of rubber or thermoplastic material; be resistant to abrasion, cracking and crazing; and the effects of ultraviolet exposure and ozone and be of uniform thickness and free from defects. Defects may include but are not limited to bubbles, thinning, gouging or discoloration.

6.5 Static electricity dissipation

Hose assemblies shall be constructed so as to provide for electrical bonding.
Additionally, Type B hoses shall be electrostatically dissipative.

7. Dimensions and tolerances

7.1 Diameters

When measured in accordance with ISO 4671, typical diameters of hoses are given in Table 2.

Table 2 — Typical Diameters of hoses

Nominal size	Inside diameter mm		Maximum outside diameter of hose mm
	min.	max.	
6,3	5.9	7,0	25
8	7,7	8,5	30
10	9,3	10,1	35
Other sizes	TBD	TBD	TBD

7.2 Concentricity

When measured in accordance with ISO 4671, the concentricity of hoses shall conform to Table 3.

Table 3 Concentricity

Nominal size	Maximum variation in wall thickness between inside diameter and outside diameter mm
Up to and including 6,3	0,8
Over 6,3 and less than or equal to 10	1,0
Greater than 10	TBD

8 Marking

Marking of hoses is a function of the hose design and the hose assembly fabrication. In some cases, the hose manufacturer is the hose assembly manufacturer (makes the hose, the hose fitting, assemblies and tests the assembly). However, often times the hose, end fitting and the assembling is done by different entities. In this case; the hose, the end fitting and the assembly each have special marking requirements.

8.1 Hoses

Hoses shall be marked with at least the following information, and the marking shall be repeated every 760 mm or less.

a) Classification; Pressure, temperature rating, type, (e.g. H70/T0/A);
b) manufacturer's name or identification, e.g. MAN;
c) manufacturer's factory identification (MFG internal code); e.g. FAC, if necessary
d) notifying body identification name or LOGO; e.g. NOT, if necessary
e) number of this International Standard, i.e. ISO 19880-5;
f) nominal size, e.g. 8;
g) quarter and last two digits of the year of manufacture, e.g. 3Q16.

EXAMPLE H70/T1/A/MAN/FAC/NOT/ISO 19880-5/8/3Q16

Note: Letter height shall be a minimum of 15 % of the hose cover outer circumference.

8.2 Hose end fitting

Hose end fittings be permanently marked with the following information only necessary in the case fittings are supplied as single article:

a) Pressure classes, e.g. H70;
b) Manufacturer's identification, name, LOGO, or Trade Mark, e.g. MAN
c) Material heat code, e.g. HCT#;
d) Number of this International Standard, i.e. ISO 19880-5;
e) Nominal size, e.g. 8;
f) Assembly date (Quarter and Year)

EXAMPLE H70/MAN/HCT#//ISO 19880-5/8/

NOTE In the case where the hose manufacturer is also the assembly fabricator, only c) and f) are necessary.

8.3 Hose assemblies

Hose assemblies shall be marked with at least the following information:

a) Proof Test Pressure
b) Date of test
c) Number of this International Standard, i.e.ISO 19880-5;
d) Assembler (FAB) name or LOGO
e) Assembly date (Quarter and Year)

EXAMPLE PTP/Date/ISO 19880-5/3Q16

1) The maximum working pressure of the assembly is the lowest maximum allowable working pressure of any of its components.

2) Hose assemblies shall be marked by the following methods;
   a) stamping on at least one of the couplings;
   b) molding in at least one of the couplings;
   d) molded rubber name plate cemented in place;
   e) metal tag or bracket-type marking retained by at least one of the couplings; or
   f) printing on a pressure sensitive label of polyester film.

In the case where the hose manufacturer is also the assembly fabricator, the requirements of 8.1 and 8.2 are sufficient to meet the requirements in 8.3.
However, g) two digits indicating the month of assembly of clause 8.3 shall be marked.

9 Performance

9.1 Leakage

A hose assembly shall not leak or fail when tested in accordance with ISO 4080:2009 Method 2, with the following conditions, hose assembly shall show no leakage or failure. The hose cover with perforated holes may be used as a sample.
The leakage shall be checked visually for any bubbles from both end fittings.
Also a leak detection fluid test may be applied to check leakage.

Test pressure: MAWP
Test gas: Hydrogen
Pressure hold time: 5 min

Note: Leakage can be tested by Permeation Test at the first 5 min according to this procedure.

9.2 Hydrostatic Strength

9.2.1 Proof pressure test

When tested in accordance with ISO 1402, a hose assembly shall withstand without bursting or visible loss of fluid with the pressure of two times of MAWP for 5 min.

As a test fluid, water or oil can be used.

This is a non- destructive test,

9.2.2 Ultimate Strength

When tested in accordance with ISO 1402, a hose assembly shall withstand without bursting or visible loss of fluid with the pressure of 3,5 times of MAWP or 4 times of MOP for 5 min.

As a test fluid, water or oil can be used.

This is a destructive test, do not use these test samples for any further testing or for resale.

9.3 Ultraviolet Resistance and Water Exposure Test

In accordance with ISO 30013:2011, after the exposure test with the conditions listed below, all hose samples shall be visually checked and there shall be no signs of crazing or cracking.

Test conditions:

Types of test piece: Type 1 (sample of hose with U-shape bent)

Light source: Fluorescent UV lamps Type 1A (UVA-340), Irradiance 0,76 W at 340 nm

Exposure cycles: Method A: Artificial weathering

Dry	8 h at 60℃
Condensation	4 h at 50℃

Length of exposure:

The test sample shall be cycled continuously under the previously specified cycle pattern for 10 weeks or 1680 h hours.

The test sample may be repositioned once per week to obtain uniform exposure to UV radiation, moisture and temperature. Follow manufacturer's recommendation for rotation.

9.4 Electrical Conductivity

When determined in accordance with clause 4.8 of ISO 8031:2009, electrical resistance between couplings at each end of a dispenser hose shall not exceed 1MΩ per meter, in order to dissipate static electricity.

This test shall be conducted with the hose un-pressurized.

For Type B Hose: TBD

9.5 Kink Resistance- (Minimum Bend Radius)

9.5.1 Dispenser Hoses - Type A Hose

When tested in accordance with method B of ISO 10619-2: 2011 at a minimum temperature of the hose being rated the hose shall not become damaged or leak and shall meet the electrical resistance limits specified in Section 9.4, Electrical Conductivity when tested as follows.

This is a destructive test, do not use these test samples for any further testing or for resale.

Bend a hose at -40°C degrees to a half of the Minimum Bend Radius given in Table 4 (along the mandrel size of a half of Minimum Bend Radius) Hold the hose in position for 1 minute, then straighten the hose and allow it to recover for 2 min. Repeat this procedure for 100 cycles. Upon completion of the cycling, check the following:

a. Check for compliance with Section 9.2.1 Hydrostatic Proof test

b. Check for compliance with Section 9.4, Electrical Conductivity, as applicable.

c. If the hose is kinked, cut the hose at the location of the kink and inspect it for delamination, cracking or breaking.

Table 4— Minimum bend radius

Nominal size	Minimum bend radius mm				
	H11	H25	H35	H50	H70
6,3	TBD	TBD	150	TBD	200
8	TBD	TBD	TBD	TBD	250
10	TBD	TBD	200	TBD	TBD
As specified by manufacturer	TBD	TBD	TBD	TBD	TBD

This test shall be applied to each nominal diameter, type and material of hose submitted for examination under this requirement.

9.6 Torsion Strength

This test does not apply to a bonded supply/vent line. This provision applies to a single hose only.
When tested in accordance with ISO 6802 with the conditions listed below, a dispenser hose shall withstand 1000 cycles of a horizontally reciprocating movements under atmospheric pressure without damage to the hose or fittings and without leakage in excess of the rate specified in Section 9.2.1 Hydrostatic Proof Test.

Test conditions

Apparatus: Method 2 horizontally reciprocating manifold
Mounting of hose assembly: Offset the sample hose at the distance of four times of outside diameter of hose
Pressure: Atmospheric pressure
Temperature: -40℃
Required cycle: 1000 cycle

9.7 Tensile Test of Hose Assembly

This provision applies to a single Type A hose only. For a bonded supply/vent line, only the supply portion of the bonded supply/vent line hose shall be tested. This test does not apply to the vent portion of the bonded supply/vent line hose.

A hose assembly shall withstand a longitudinal pull force of 2000 N without structural damage or leakage after being subjected to accelerated air oven aging. The hose must comply with Section 9.2.1 Hydrostatic Proof Test and Section 9.5 Electrical Conductivity after the tensile test.

Method of Test

The hose assembly shall be air oven aged for 70 hours at

- 85°C ± 1°C for “A” rated hoses;

Following the oven aging, the hose assembly shall be maintained at room temperature for 2 h prior to the conduct of the tensile test.

The apparatus outlined in ISO 188 Rubber, vulcanized or thermoplastic -- Accelerated ageing and heat resistance tests shall be used for this test.

The hose end fittings shall then be assembled with corresponding companion parts and tightened. The hose is then to be placed in a tensile testing machine and connected so that the end fittings and hose are subjected to the 2000 N. With the testing machine adjusted for a rate of travel of 0.2 mm/sec or slower, the pull force is to be applied until 2000 N is attained.

At the completion of this test, hose assemblies shall be subjected to and shall comply with Sections 9.2.1 Hydrostatic Proof Test and 9.5 Electrical Conductivity.

9.8 Ozone Resistance

When tested in accordance with method 1 of ISO 7326: 2006, depending on the nominal size of the hose, a hose outer cover shall show no visible signs of cracking or damage under X2 magnification after 72 hours of exposure with an ozone partial pressure of (100±5) pphm (parts per hundred million) at temperature of (40±1) ° C (The area immediately adjacent to the wire shall be ignored).

9.9 Corrosion Test

This test shall be applied to Type A, B hose and hose assemblies.

When tested in accordance with ISO 9227:2012 with the conditions listed below, fittings and other metal parts shall not show evidence of corrosion or other deterioration.

Minor corrosion is allowed on areas where there is mechanical deformation of the plating or coating caused by crimping, flaring, bending and other post-plate metal forming operations.

At the completion of this test, hose assemblies shall be subjected to and shall comply with Sections 9.2.1 Hydrostatic Proof Test.

Test conditions

Test specimen: hose assembly
Test method: Acetic Acid Salt Spray (AASS)
Temperature:（35±2)℃
Duration of test: 96 h

This test shall be applied to each nominal diameter, type and material of hose end fitting submitted for examination under this requirement.

9.10 Pressure Cycle Test (Impulse Test)

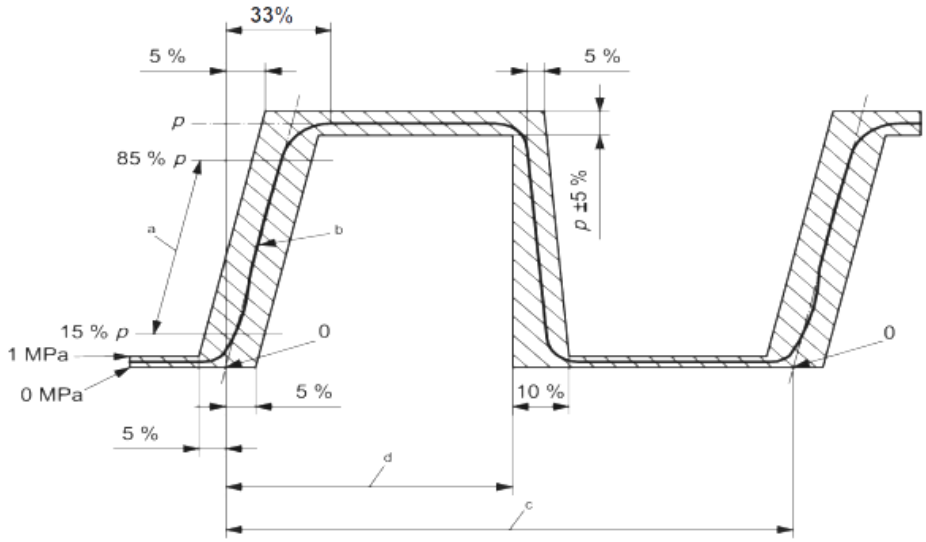
When tested in accordance with ISO 6803, the test fluid temperature shall be 65 °C. The pressure rise shall be contained within the wave form envelope as shown in Figure 1.

The test fluid for this test is oil or water.

When tested at impulse pressure equal to 100 % of the maximum operating pressure, the hose shall withstand a minimum of 100 000 impulse cycles.

There shall be no leakage or other malfunction before reaching the specified number of cycles.

This test shall be considered a destructive test and the test piece shall be destroyed.



Key

p	test pressure
a	rate of rise to be determined between these points (50 MPa/s to 100 MPa/s)
b	secant pressure rise
c	one pulse cycle (0,1 Hz to 0,4 Hz)
d	45 % to 55 % of the cycle

Figure 4 — Pressure pulse wave

9.11 Marking Material Legibility

The legibility of marking materials shall not be adversely affected when marking materials are exposed to heat and moisture as specified in the following Method of Test.

This section applies only to markings other than those that are embossed, cast, stamped or otherwise formed in the part.

Method of Test

The following tests shall be conducted on two samples. The manufacturer shall have applied the marking materials to the hoses as they would be applied in production.

a. Marking materials shall exhibit no illegible or defaced printing when rubbed with thumb or finger pressure.

b. The marking materials shall then be placed in an oven for a period of 2 weeks with the oven temperature maintained at 85°Cas applicable based on the temperature rating (see Section 1).

Following the oven test, the legibility of the samples shall be checked again as specified in “-a” above. Samples shall then be immersed in water for a period of 24 h, after which the legibility shall be rechecked as specified in “-a” above.

Good legibility shall be obtained for all samples under the above specified test conditions

9.12 Hose Permeation

When tested in accordance with Method 1 of ISO 4080: 2009 with the conditions listed below, the hourly permeation rate shall be less than 500 cm3/m. Section the hose and inspect the internal surfaces for any evidence of cracking, deterioration or lining delamination. Inspect outside of hose for any blistering or swellings. This outside inspction is to verify hose cover Perforation.

A suitable pressurizing system, capable of supplying the gaseous medium at the required test pressure, and a suitable flow-measuring device, capable of measuring the leakage rate with an accuracy of 2 % percent, shall be connected to the inlet of a test sample. The flow measuring device shall be located between the pressuring system and the test sample to be pressurized. The outlet of the test sample shall be sealed by any convenient means.

The gaseous medium shall be gradually admitted to the test sample so that a uniform gauge pressure of not less than 1.1 times the specified maximum allowable working pressure, or 1.5 times service pressure, is attained within one minute. This pressure shall be maintained for at least 5 minutes, at which time any leakage as indicated by the flow measuring device shall be noted.

Test conditions:

Test apparatus: Method 1
Test gas: Hydrogen
Test pressure: at MOP
Duration of the test: 72 h

Note: Leakage can be tested at the first 5 min of this test. During Leakage testing, MAWP is applied.

Standard pressure and temperature conditions are 101.325 kPa at 15°C. If the condition of standard pressure and 15℃ cannot be controlled, record the pressure and temperature at the test and comvert the result to cm3N using the following formula.

$$V0 = Vm \times \frac{273 \times \left[\frac{Pt - SVP@Tt \times RH@Tt}{Pt} \right]}{273 + Tt}$$

V0:	cm3N (after conversion)
Vm:	measured Leak ammount in cm3
Pt:	Pressure at test in MPa
SVP:	Satulated Vapor Pressure at Tt
Tt:	Temperature at test
RH:	Relative Humidity

9.13 Hydrogen Impulse Test

TBD by CD or DIS stage.

9.14 Optional Crush Test

If required based on regional dispenser design, a dispenser hose assembly (Type “A”) shall withstand a force of 8900 N applied externally without incurring structural damage or leakage.

Method of Test

The length of the sample hose assembly shall be a minimum of 610 mm. The hose shall be placed against a hard, flat, smooth metallic surface. A force or weight equivalent to 8900 N shall be uniformly applied for 15 min to the hose, with the force or weight evenly distributed over 150 mm of hose length in the approximate center of the sample. The weight shall then be removed and the hose subjected to and shall comply with Sections 9.2.1 Hydrostatic Proof Test and 9.4 Electrical Conductivity.

If applicable, both hoses of a bonded supply and vent hose, shall be on a horizontal plane when tested. Both hoses must be in contact with the crushing fixture.

9.15 Optional Abrasion Resistance Test

For hoses over 3 metres in length or where regional dispenser designs warrant, Dispenser hoses must meet a modified ISO abrasion resistance test, namely International *Standard ISO/PWI 20444, Rubber Hoses - Determination of Abrasion Resistance of the Outer Cover* (currently under construction in TC45/SC1 Hose) modified as follows.

10 Frequency of testing

Type tests and routine tests shall be carried out as specified in Annex A.

Type tests are those required to confirm that a particular hose or hose assembly design, manufactured by a particular method from particular materials, meets all the requirements of this International Standard. (The tests shall be repeated at a maximum of five-year intervals, or whenever a change in the method of manufacture or materials used occurs). They shall be performed on all sizes and types except those of the same size and construction.

Routine tests are those required to be carried out on each length of finished hose or hose assembly prior to dispatch.

Production acceptance tests are tests specified in Annex B, which should preferably be carried out to control the quality of manufacture. The frequencies specified in Annex B are given as a guide only.

11 Test report

When requested by purchaser, the manufacture or supplier will supply a test report representing the purchased product each length or batch of hoses.

Annex A
(normative)

Type tests and routine tests

Table A.1 gives the tests to be carried out for type testing and routine testing as defined in clause 10.

Table A.1

Property	Type test			Routine test		
	Hose	Assem-bly	Number of sample	Hose	Assem-bly	Number of sample
Visual examination (inside and outside)	**X**	**---**	**min. 6**	**X**	**---**	**min. 3**
Measurement of inside diameter	**X**	**---**	**min. 6**	**X**	**---**	**min. 3**
Measurement of outside diameter	**X**	**---**	**min. 6**	**X**	**---**	**min. 3**
Measurement of concentricity	**X**	**---**	**min. 6**	**X**	**---**	**min. 3**
9.1 Leakage test	**---**	**X**	**min. 2**	**---**	**---**	**---**
9.2 Hydrostatic Strength 9.2.1 Proof Test	**---**	**X**	**min. 2**	**---**	**X**	**min. 3**
9.2.2 Ultimate Strength	**---**	**X**	**min. 2**	**---**	**---**	**---**
9.3 Ultraviolet Light	**X**	**---**	**4 includes 1 blank**	**---**	**---**	**---**
9.4 Electrical Conductivity		**X**	**min. 1**	**---**	**---**	**---**
7.5 Kink Resistance (Minimum Bend Radius	**X**	**---**	**min. 3**	**---**	**---**	**---**
9.6 Torsion Strength		**X**	**min. 3**	**---**	**---**	**---**
9.7 Tensile Test of Hose Assembly		**X**	**min. 2**	**---**	**---**	**---**
9.8 Ozone Resistance	**X**		**min. 3**	**---**	**---**	**---**
9.9 Corrosion Test	**---**	**X**	**min. 2**	**---**	**---**	**---**
9.10 Pressure Cycle Test (Impulse Test)	**---**	**X**	**min. 3**	**---**	**---**	**---**
9.11 Marking Material Legibility	**X**	**---**	**min. 2**	**---**	**---**	**---**
9.12 Hose Permeation	**X**	**---**	**min. 1**	**---**	**---**	**---**
9.13 Hydrogen impulse Test	**---**	**X**	**min. 3**	**---**	**---**	**---**
9.14 Optional Crush Test	**X**	**---**	**min. 2**	**---**	**---**	**---**
9.15 Optional Abrasion Resistance Test	**X**	**---**	**min. 3**	**---**	**---**	**---**

Annex B
(informative)

Production acceptance tests

Table B.1 gives the tests to be carried out for Production acceptance tests as defined in clause10.

Table B.1

Property	Production Acceptance tests		
	Hose	Assembly	Number of sample
Visual examination (inside and outside)	**X**	**---**	**min. 3**
Measurement of inside diameter	**X**	**---**	**min. 3**
Measurement of outside diameter	**X**	**---**	**min. 3**
Measurement of concentricity	**X**	**---**	**min. 3**
9.1 Leakage test	**---**	**---**	**---**
9.2 Hydrostatic Strength Proof Test	**X**	**---**	**min. 2**
Ultimate Strength	**X**	**---**	**min. 2**
9.3 Ultraviolet Light and Water Exposure Test	**---**	**---**	**---**
9.4 Electrical Conductivity	**---**	**---**	**---**
9.5 Kink Resistance	**---**	**---**	**---**
9.6 Torsion Strength	**---**	**---**	**---**
9.7 Tensile Test of Hose Assembly	**---**	**X**	**min. 2**
9.8 Ozone Resistance	**---**	**---**	**---**
9.9 Corrosion Test	**---**	**---**	**---**
9.10 Pressure Cycle Test	**---**	**X**	**min. 3**
9.11 Marking Material Legibility	**---**	**---**	**---**
9.12 Hose Permeation	**---**	**---**	**---**
9.13 Hydrogen impulse Test	**---**	**---**	**---**
9.14 Crush Test (Optional)	**---**	**---**	**---**
9.15 Abrasion Resistance Test (Optional)	**---**	**---**	**---**